November 2006
AOML STEPS TO QUALITY CONTROL (QC) TSG DATA

The data are processed in three phases:

1. The version of the output data file is identified, so the consistency of the data is checked by the format and type. Once the file is interpreted, the data are stored in a standardized format.
2. A reduced QC Is applied to detect primary for sensor and formats errors. Several steps are applied here (see bellow: 1, 2, 3, 5, 6, 8, and 10). The approved data are sub-sampled onto a 5 minute spaced dataset.
3. The reduced dataset is checked against all the steps bellow and the adequate flags are computed for each 5 minute data point.

Quality Control Steps

Step 1 : platform identification
The platform must have a valid call sign number. If this test fails, all measurements remain flagged as 0 (no quality control performed).

Step 2 : impossible date
The date and time of an observation have to be correct.
* Year on 4 digits
* Month in the range 1 to 12
* Day in a range expected for the corresponding month
* Hour in the range 0 to 23
* Minute in the range 0 to 59
* Second in the range 0 to 59

If any one of the conditions above fails, the date is flagged as wrong (flag=4).

Step 3 : impossible location
This test requires that the observation latitude and longitude from the platform be correct.
* Latitude within the range -90 to 90
* Longitude within the range -180 to 180

If either latitude or longitude fails, the position is flagged as wrong.

Step 4 : Position on Land Step
This test requires that the latitude and longitude of the observation not be located over land. The ETOPO5/TerrainBase file is used to see if each data point is

located on land. If the data cannot be located at sea, the position is flagged as wrong.

Step 5 : impossible speed
The speed between 2 observations cannot exceed a maximum value. If the speed is higher than permitted for the platform (usually cargo or research ship), the location, date or identification of the platform may be incorrect. The speed is calculated between an observation and the previous one. If there is no previous observation, the test is correct. If the test fails, location and date are flagged as wrong.

Step 6 : global ranges
This test applies a gross filter on observed values for temperature and salinity. It needs to accommodate all of the expected extremes encountered in the oceans.
- Temperature within range –2.5 to 45.0 °C.
- Salinity within range 0.0 to 60.

If a value fails, it should be flagged as wrong.

Step 7 : regional ranges
This test applies to only certain regions of the world, where conditions can be further qualified. For example, specific ranges for observations from the Mediterranean and Red Seas further restrict what are considered sensible values. The Red Sea is defined by the region 10°N,40°E; 20°N,50°E; 30°N,30°E; 10°N,40°E and the Mediterranean Sea by the region 30°N,6°W; 30°N,40°E; 40°N,35°E; 42°N,20°E; 50°N,15°E; 40°N,5°E; 30°N,6°W.
- Red Sea:
  Temperature within range 21.7 °C to 40.0 °C
  Salinity within range 0.0 to 41.0
- Mediterranean Sea
  Temperature within range 10.0°C to 40°C
  Salinity within range 0.0 to 40.0

Individual values that fail these ranges are flagged as wrong.

Step 8 : spike test
A difference between sequential measurements, where one measurement is quite different than adjacent ones, is a spike in both size and gradient.
Test value = $| V2 - (V3 + V1)/2 | - | (V3 - V1) / 2 |$,
where V2 is the measurement being tested as a spike, and V1 and V3 are the values previous and next.
- Temperature: The V2 value is flagged when the test value exceeds 6.0°C.
- Salinity: The V2 value is flagged when the test value exceeds 0.9.

Values that fail the spike test are flagged as wrong and are not distributed.

Step 9: constant value test
This test is failed when there is no difference in the values of the measured parameters during a six hour period.

Step 10 : gradient test
This test is failed when the difference between adjacent measurements is too steep.
Test value = | V2 - (V3 + V1)/2 |
where V2 is the measurement being tested as a spike, and V1 and V3 are the previous and next values.
- Temperature: The V2 value is flagged when the test value exceeds 9.0°C.
- Salinity: The V2 value is flagged when the test value exceeds 1.5.

Values that fail the test (i.e. value V2) are flagged as wrong.

Step 11 : climatology and NCEP weekly analysis
Each measurement is compared against a monthly climatology (Levitus 2001, 1°x1°, monthly) and against the NCEP weekly analysis fields.
The test fails if | V1 – V2 | > 3 * Sigma
- V1 : value to be controlled,
- V2 : value of the climatology or NCEP field.
- Sigma : standard deviation of the climatology

If the test fails, the data point is flagged as "out of statistics" (flag 2). However, the data is still distributed distributed.

Step 12 : buddy check
Each measurement is compared with profiling floats, XBTs, CTDs, thermistor chain and drifter data (referred here as 'buddy') within 100 km and ±5 days of the TSG measurement.
Test value = | V1 – V2 | ,
where V1 is the value to be controlled and V2 is the value of the buddy.
- Temperature: The V1 value is flagged when the test value exceeds 0.5°C
- Salinity: The V1 value is flagged when the test value exceeds 0.2

Step 13: Water Samples
Salinity data are compared against salinity measurements derived from water samples taken during the transect (if available).

Step 14: Calibrations
Data are corrected using the calibration coefficients provided by Seabird.